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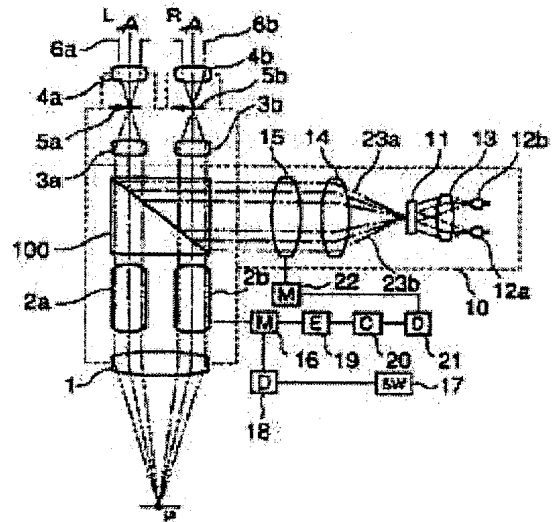
(71)Applicant : OLYMPUS OPTICAL CO LTD
(72)Inventor : UEDA MASAOKI
ISHIKAWA TOMONORI

(54) MICROSCOPE FOR SURGERY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a microscope for surgery which facilitates the change of observation methods, such as observation with one eye and observation with both eyes, according to the images to be displayed in superposition and the applications for use of these images and can be achieved with small-sized constitution.

SOLUTION: This microscope for surgery introduces the image of an LCD 11 capable of displaying the electronic image to a pair of right and left eyepiece optical systems 4a and 4b and irradiates the LCD 11 with the illumination light of at least a pair of the right and left illumination light sources 12a and 12b. The positions of the exit pupils by the eyepiece optical systems 4a and 4b and the positions of the illumination light sources are arranged in approximately conjugate positions.



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CLAIMS

[Claim(s)]

[Claim 1] an exit pupil have the following and according to said eyepiece optical system, and said illumination method — abbreviated — an operating microscope having arranged in a conjugate position.

An image formation optical system of a right-and-left couple which makes light flux emitted from an objective optical system which enters light from an object, and this objective optical system a right-and-left-eyes image, and carries out image formation.

An eyepiece optical system of a right-and-left couple which leads said right-and-left-eyes image to an observer's right and left eyes, respectively.

An optical modulation means which can display an electronic image.

A relay optical system which leads an electronic image generated by said optical modulation means to an image formation position by an image formation optical system of said right-and-left couple, and an illumination method and an illumination-light study system which irradiate with illumination light towards said optical modulation means.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the operating microscope used for the neurosurgery etc. on which an operation is performed for a detailed part, especially it is related with the operating microscope which can pile up and display an electronic image on a microscope optical-observations image.

[0002]

[Description of the Prior Art]In recent years, in surgery fields, such as a department of cranial nerves, and ophthalmology, a detailed operation is ensured especially, and also [required] the operating microscope which carries out magnified observation of the operating area in three dimensions is used abundantly.

[0003]In order more certain and to perform an operation on low invasion in conducting the operation by an operating microscope these days, The integrating process of the medical imaging of the operating area circumference obtained by CT, MRI, etc. is carried out to before an operation by computer, and the surgical operation support device which performs the position of a tumor site, the check of the range, etc., and what is called a navigation system are used together. By using such a navigation system and an operating microscope, cooperating, the information that how much size of a tumor is in the position of what mm beyond from the position which the way person is observing can be provided now as computer graphics. For this reason, an operation can be trustworthier and can carry out to low invasion. The art it enabled it to display, doubling the range of a direct tumor in piles on the optical-observations image of an operating microscope now is also proposed.

[0004]The camera array which detects the three-dimensional position of an operating microscope or an endoscope, and the computer linked to this constitute the navigation system used with an operating microscope so that it may be known for Tokuganhei11-14659. And to the computer, the information on the medical imaging beforehand obtained by CT, MRI, etc. of the operating area circumference is memorized, An observer is provided with various information, including the picture information etc. of the situation of the inside of the body which is not actually visible by the present information or eye of an operation part, required for an operation as compared with the position information detected by the camera array based on these pictures. If such a navigation system is used, the situation etc. of parts, such as a tumor which has not been exposed not only to the observing object which is visible with an operating microscope but to the part surface, can know an overview including the circumference of the operation part.

[0005]To a part of single-sided optical path of the binocular optical system which constitutes an operating microscope in JP,H5-215971,A. What made the superimposed display possible by the single-sided observation optical path of the operating microscope is proposed by arranging the liquid crystal device (hereafter referred to also as LCD) and projection optical system which display a beam splitter (it is also hereafter called B/S) and what is called an electronic image.

[0006]To Tokuganhei11-14659 described previously, a binocular optical system An ocellus optical system, Constitute from a binoculars pipe optical system which leads the observation images of a couple to an observer's right and left eyes in response to the light flux from this ocellus optical system, and arrange B/S in the afocal light flux of said ocellus optical system, and. The projection optical system which leads the electronic image by LCD to the position of this B/S is arranged, and what enabled both-eyes observation of said picture superimposing is proposed.

[0007]Arrange two reflection type LCD which displays the picture which gave the polarization component by the illumination light by polarization type B/S in this kind of operating microscope in JP,2001-108905,A, and. By arranging a polarizing plate in a right-and-left observation optical path, the picture of two LCD is led to observation images on either side, respectively, and, thereby, what the observer made picture superimposing 3D (solid) picture by displaying the picture which gave right-and-left azimuth difference to each LCD, and closed observation if possible is proposed.

[0008]

[Problem(s) to be Solved by the Invention]The observation images in which an operating microscope observes an operating area according to the independent observation optical path of two right and left build what is called a stereoscopic microscope that naturally serves as a solid (3D) picture.

[0009]However, in the thing of JP,H5-215971,A mentioned above, since picture superimposing enters into the observation optical path of one side, as a result of displaying the two-dimensional picture which depth information moreover does not have into a stereoscopic picture, a way person will sense unnaturalness for a actual focal

position and the position of picture superimposing.

[0010]Two optical systems for exclusive use which have LCD91, B/S92, and the projection optical system 93, respectively needed to be provided in the both sides of each observation optical path in order to solve this problem and to display picture superimposing, as shown in drawing 10. Since it is such composition, the problem of the whole device being complicated and enlarging arises.

[0011]Tokuganhei11-14659 is for solving such a problem, and if possible in superposition observation of both eyes at one LCD, it is closed. However, since one LCD image (2D) is observed to both-eyes coincidence in this case, 3D picture cannot be superimposed.

[0012]For example, in combination with the navigation device currently indicated by JP,H5-215971,A and JP,2001-108905,A, As a picture which shows the tumor range from the picture acquired to before an operation by CT, MRI, etc., 3D picture cannot be built and this cannot be superimposed on 3D optical-observations image by an operating microscope. Therefore, displaying as a picture of 2D in one point set up beforehand is only made as for an observation focal position etc. to what kind of case.

[0013]In order to solve such a problem, at the thing of JP,2001-108905,A, it is considered as the thing in which superposition observation of 3D is possible by one LCD. However, if it was in the case of this method, the polarizing plate needed to be placed into the observation optical path on either side, and there was a problem of the observation images of the operating microscope itself becoming dark, or image quality deteriorating.

[0014]If an LCD image is generally superimposed on a shape of microscopic features, degradation of an optical-observations image will not be avoided in a luminosity, resolution, a color, etc. On the other hand, since what is necessary is just to be only able to recognize data as a picture to superimpose, for example in the case of what is called characters, such as an output value of the electrotome, and a recorded state of VTR, the display by an ocellus is enough. However, in the example of precedence of Tokuganhei11-14659 or JP,2001-108905,A, it always became superposition with both eyes, and there was a fault of degrading observation images more than needed.

[0015]There is a place which this invention is made paying attention to the problem of the conventional technology mentioned above, and is made into the purpose in the superposition observation of the display image by an optical modulation means being made to be carried out certainly brightly in an eyepiece optical system in the operating microscope in which a superimposed display is possible at the magnified observation image of an operating area about an electronic image.

[0016]

[Means for Solving the Problem]An image formation optical system of a right-and-left couple which this invention makes light flux emitted from an objective optical system which enters light from an object, and this objective optical system a right-and-left-eyes image, and carries out image formation, An eyepiece optical system of a right-and-left couple which leads said right-and-left-eyes image to an observer's right and left eyes, respectively, An optical modulation means which can display an electronic image, and a relay optical system which leads an electronic image generated by said optical modulation means to an image formation position by an image formation optical system of said right-and-left couple, an exit pupil provide an illumination method and an illumination-light study system which irradiate with illumination light towards said optical modulation means, and according to said eyepiece optical system, and said illumination method --- abbreviated --- it is an operating microscope having arranged in a conjugate position.

[0017]According to this invention, since said illumination method is projected on an exit pupil position of a right-and-left eyepiece optical system, in an eyepiece optical system on which this illumination method was projected, superposition observation of the display image by said optical modulation means is carried out certainly brightly.

[0018]From it being easy to build optical composition so that an illumination method which is different in each exit pupil position of a right-and-left eyepiece optical system may be projected, if premised on this invention. In an eyepiece optical system by which this illumination method was projected on said optical modulation means (LCD) according to a state of an illumination method (light source) for displaying a picture, composition whose change of various observation, such as the one eye, both eyes, two dimensions, and a three dimension, is attained can be built with an easy and small structure.

[0019]

[Embodiment of the Invention][A 1st embodiment] The operating microscope applied to a 1st embodiment in this invention according to drawing 1 and drawing 2 is explained.

[0020]Drawing 1 is an explanatory view of the rough composition of the microscope optical system of the operating microscope concerning this embodiment, and shows the image formation (relay of image) state of the electronic image displayed on transmission type LCD superimposed on microscope observation images. Drawing 2 is an explanatory view of an image formation (relay of pupil) state of the light source which illuminates transmission type LCD in said microscope optical system.

[0021](Elements of the Invention) As for the numerals 1, among drawing 1, similarly the variable power optical system of a right-and-left couple, and 3a and 3b are the eyepieces (eyepiece optical system) of a right-and-left couple, and, as for the image formation optical system of a right-and-left couple, and 4a and 4b, the substance observation optical system of the operating microscope is constituted [an object lens, 2a, and 2b] by these. Each image formation point formed with said image formation lenses 3a and 3b is shown by the numerals 5a and 5b in the said figure. said eyepieces 4a and 4b --- the exit pupil which is boiled, respectively and is depended is shown by the numerals 6a and 6b in the said figure.

[0022]Next, the superimposing optical system 10 for superimposing an electronic image on the microscope

observation images of said substance observation optical system is explained. The numerals 11 shown in drawing 1 and drawing 2 are transmission type LCD (liquid crystal modulator) used as an optical modulation means, control the abnormal conditions of the illumination light by electronic data, and display what is called an electronic image. LED12a of the right-and-left couple used as the light source which irradiates with the illumination light towards transmission type LCD11 with the illumination lens 13, and 12b are arranged at the backside of this transmission type LCD11. any of the illumination light which each LED12a which comprises LED12a which all becomes the point light source in this embodiment, and 12b, and becomes the point light source, and 12b emit -- although -- the illumination-light study system constituted so that it might glare towards transmission type LCD11 through the illumination lens 13 is built.

[0023]The numerals 14 in the drawing 1 and drawing 2 are LCD relay optical systems which relay the electronic image of said transmission type LCD11, and the numerals 15 are LCD variable power optical systems which change the magnification of this electronic image. The numerals 100 are half prism arranged in the field of a substance observation optical system, and carry out the light guide of the light in which the light guide was carried out by the LCD variable power optical system 15 into the field of said substance observation optical system.

[0024]Here, as shown in drawing 1, the position of the graphic display side of said transmission type LCD11 has a position of said image formation points 5a and 5b, and a conjugate relation with the image formation lenses 3a and 3b of said relay optical system 14 and an image formation optical system. As shown in drawing 2, each position of said LED12a and 12b is in each exit pupil positions 6a and 6b of these eyepieces 4a and 4b, and conjugate respectively physical relationship by the illumination lens 13, the relay optical system 14, the image formation lenses 3a and 3b, and the eyepieces 4a and 4b.

[0025]Both lightings, putting out lights, or only one of the two's lighting can be chosen by the illumination method control circuit (change control means) which is not illustrated, and LED12a used as said illumination method (light source) and 12b can switch now the turning-on-and-off state.

[0026]The numerals 16 in drawing 1 are the motors for driving the drive mechanism which makes the interval of the lens group which constitutes said variable power optical system 2a and 2b change along an optical axis direction and which is not illustrated, This motor 16 is connected to the driver circuit 18 which outputs a driving signal with the manipulate signal from the input means of foot switch 17 grade. The encoder 19 which detects the number of rotations of this motor 16 is connected to said motor 16. 20 is a magnification arithmetic circuit and this magnification arithmetic circuit 20 computes the magnification of said variable power optical system 2a and 2b by the detection result of the encoder 19. The magnification of the LCD variable power optical system 15 is computed so that the electronic image displayed on transmission type LCD11 by said superimposing optical system 10 may serve as an observed image of a substance observation optical system, and the magnification from this calculation magnification result. The numerals 21 are driver circuits and this driver circuit 21 outputs a driving signal to the motor 22 which drives the drive mechanism which makes the lens interval which constitutes said LCD variable power optical system 15 according to the magnification signal from the magnification arithmetic circuit 20 change, and which is not illustrated.

[0027](OPERATION) By the above composition, a way person performs solid observation for the light which emitted the operating area P via the variable power optical system 2a, 2b, the image formation lenses 3a and 3b of an image formation optical system, and the eyepieces 4a and 4b.

[0028]When changing the magnification about this observed image, by operating the foot switch 17, a manipulate signal is sent to the driver circuit 18, and a drive signal is outputted to the motor 16 from the driver circuit 18. The drive mechanism which changes by this the interval of the lens group which constitutes the variable power optical system 2a and 2b and which is not illustrated drives, and the interval of this lens group is changed. being appropriate -- it is alike and solid observation of the operating area P is made for the magnification of a way person's request.

[0029]Under the present circumstances, the number of rotations of this motor 16 is detected by the encoder 19 connected to said motor 16, and observing power is computed by the magnification arithmetic circuit 20 by this detection result. The magnification of the LCD variable power optical system 15 which coincides the magnification of the display image by transmission type LCD11 with an optical-observations picture as a way person's observation images is computed by this observing power result, and by this computed result. the motor 22 drives by an input signal being sent to the driver circuit 21 -- being appropriate -- it is alike and the LCD variable power optical system 15 is set as said calculation magnification.

[0030]Next, when a way person does the superimposed display of the electronic images, such as an outline display of the tumor by a navigation device, on an optical-observations picture, transmission type LCD11 is set to ON with the input switch which is not illustrated. Each LED12a and 12b are turned on according to this, and transmission type LCD11 is illuminated through the illumination lens 13 of an illumination-light study system. The electronic image copied out on transmission type LCD11 through the shown separate optical path with the numerals 23a and 23b in drawing 1 with the relay optical system 14, the LCD variable power optical system 15, the half prism 100, and the image formation lenses 3a and 3b. Image formation is carried out for magnification equivalent to said optical-observations picture on the separate image formation point 5a and 5b, respectively.

[0031]Image formation of turned-on LED12a and the 12b is carried out by the illumination lens 13, the relay optical system 14, the image formation lenses 3a and 3b, and the eyepieces 4a and 4b through the separate optical path shown with the numerals 25a and 25b on the exit pupil position 6a of these eyepieces 4a and 4b, and 6b by drawing 2. it is alike and a way person all becomes observable clearly with both eyes about the appropriate electronic image on which it was superimposed for equivalent magnification on the optical-observations image.

[0032]Next, the case where the display image by transmission type LCD11 is observed in the one eye is described. A way person LED12b by which image formation should be carried out to the exit pupil 6b of a right eye among said LED12a and 12b, LED12b which went out when the light was put out with the input switch which is not illustrated. The inside of drawing 2, pass the optical path shown with the dashed line 25b — pass the optical path 25a which image formation is not carried out to the exit pupil 6b of the eyepiece 4b for right eyes, and only turned-on LED12a shows according to a two-dot chain line — image formation is carried out to the exit pupil 6a of the eyepiece 4a for left eyes. being appropriate — it is alike and, for a way person, observation only by a left eye is attained in the display image of said transmission type LCD11.

[0033](EFFECT OF THE INVENTION) In this embodiment, the illumination light which projects picture superimposing by having set the exit pupil position by the eyepieces 4a and 4b of each right and left and the position of each LED12a which illuminates LCD11, and 12b as conjugate respectively physical relationship is certainly led to right- and-left both eyes, bright positive superposition observation can be performed, and according to the lighted condition of LED12a and 12b of two right and left, superposition observation can be switched easily [both eyes or the one eye], and can be observed.

[0034]Brighter positive superposition observation is attained by setting up the projecting magnification of an illumination-light study system so that LED12a by which image formation is carried out, and 12b may become small to the diameter of an exit pupil of the eyepieces 4a and 4b.

[0035]According to the picture and observation use which are displayed only by controlling lighting and putting out lights of LED12a and 12b which has an exit pupil position of the eyepieces 4a and 4b, and a conjugate relation, a change of various observation, such as the one eye, both eyes, two dimensions, and a three dimension, is attained. Since the exit pupil position of the eyepieces 4a and 4b and the position of LED12a and 12b have a conjugate relation, the composition which can switch various observation which was mentioned above can be built with an easy and small structure.

[0036][A 2nd embodiment] The operating microscope applied to a 2nd embodiment in this invention according to drawing 1 thru/or drawing 3 is explained. However, this embodiment differs only in the drive system of LED12a whose a 1st embodiment mentioned above is said transmission type LCD11 and an illumination light source, and 12b. Drawing 3 is a block diagram of the drive system of transmission type LCD11 and LED12a, and 12b.

[0037](Elements of the Invention) the numerals 30 shown in drawing 3 input two video signals, it is a switcher which carries out the selected output of one of them, and the video signal of the electronic images 31a and 31b in which the azimuth difference of each right and left was given is inputted as an input signal. On a navigation device and in before an operation [, such as CT and MR,] in this electronic image, The three-dimensional data of the outline of a tumor is built, and it divides into two pictures which gave azimuth difference on either side based on this three-dimensional data, and is made to observe in three dimensions from these pictures with the BOKUSURU data beforehand obtained from a slice picture.

[0038]The numerals 32 in drawing 3 are switches, and this inputs a manipulate signal into the control circuit 33 which controls LED driver 35 which drives LCD driver 34 and LED12a which drive transmission type LCD11, and 12b, respectively. The control circuit 33 is connected to said switcher 30 so that it may control selection of the output signal outputted from said switcher 30.

[0039](OPERATION) If, as for a way person, a superposition observation **** case operates the switch 32 for an electronic image in an optical-observations picture like the case of a 1st embodiment mentioned above, the control circuit 33 will output a driving signal to LCD driver 34. Although it doubles and a driving signal is outputted also to the switcher 30 and LED driver 35, LED driver 35 is controlled to consider the output signal of the switcher 30 as the output of the picture signal 31a with the azimuth difference for left eyes, and to be able to come, simultaneously to drive LED12a for left eyes at this time. Next, the output of the switcher 30 is switched to the picture signal 31b with the azimuth difference for right eyes, and LED driver 35 is controlled synchronizing with it to drive LED12b for right eyes. And the switch 32 is in the state of ON and the control circuit 33 continues switching these two operations in an instant. The video signal 31a with the azimuth difference for left eyes displayed on transmission type LCD11 by this is drawn at the image formation point 5a for left eyes, the video signal 31b with the azimuth difference for right eyes is drawn at the image formation point 5b for right eyes, and a way person is each observing eye. An electronic image with azimuth difference will be superimposed on an optical-observations picture, and will be observed in three dimensions.

[0040](EFFECT OF THE INVENTION) In this embodiment, the superimposed display of the electronic image with azimuth difference on either side can be carried out on each optical-observations image in one LCD11, i.e., very small composition, and an electronic image can be simultaneously observed as a three-dimensional picture within the optical-observations image which is a three dimension. In combination with the above-mentioned navigation device, the clear observation which more certainly had the information on a depth direction is attained especially.

[0041]In this embodiment, it is also easily possible to provide several sorts of numbers of input switches of the switch 32, to switch the control system of the situation ***** control circuit 33, to switch two dimensions and a three dimension, and to display.

[0042][A 3rd embodiment] The operating microscope applied to a 3rd embodiment in this invention according to drawing 4 is explained. However, since the thing of the same name as a 1st embodiment and a jack per line is the same as that of a 1st embodiment, detailed explanation of that is omitted.

[0043](Elements of the Invention) This embodiment is the display form which added the subside observation optical path which closes observation of the other way person and what is called an assistant if possible to the case of a

1st embodiment mentioned above. The numerals 40a and 40b in drawing 4 are the variable power optical systems of the added right-and-left couple for subside observation optical paths, and 41a and 41b are prism for subside observation optical paths made to reflect abbreviated 90 degrees of lights drawn by said variable power optical systems 40a and 40b. 42a and 42b are the image formation lenses of the right-and-left couple for subside observation optical paths among the figure, and 43a and 43b are the eyepieces of the right-and-left couple for subside observation optical paths, and the observation optical path of a subside constitutes the substance observation optical system by the above thing together with said object lens 1. moreover -- 44a and 44b are each image formation points formed with said image formation lenses 42a and 42b among the figure -- 45a and 45b -- said eyepieces 43a and 43b -- it is an exit pupil which is boiled, respectively and is depended.

[0044]Next, the superimposing optical system 46 in this embodiment is explained. The polarization beam splitter 48 is arranged on the emitted light axis of reflection type LCD47. In [49a and 49b are LED by the side of main among the figure, and] the incident light axis top of said polarization beam splitter 48 this LED49a and 49b. It is arranged by the illumination-light study system 51, the relay optical system 14, the image formation lenses 3a and 3b, and the eyepieces 4a and 4b at the exit pupil position of the eyepieces 4a and 4b, and the conjugate position. 50a and 50b in the figure are LED by the side of sub [it has been subarranged similarly], and are in the exit pupil position of the eyepieces 43a and 43b, and conjugate physical relationship by the illumination-light study system 51, the relay optical system 14, the image formation lenses 42a and 42b, and the eyepieces 43a and 43b.

[0045]What is called an electronic zoom function to which display magnification is set is carried in order to double the magnification of the electronic image displayed on optical-observations picture and reflection type LCD47 with the driver circuit which drives reflection type LCD47 and which is not illustrated according to the result of an operation of said magnification arithmetic circuit 20.

[0046]in addition to observation by a way person, in this embodiment, an assistant can also perform solid observation for the light which emitted the operating area P via the variable power optical systems 40a and 40b of each right and left, the prism 41a and 41b, the image formation lenses 42a and 42b, and the eyepieces 43a and 43b.

[0047]Next, a way person operates the input switch which is not illustrated like a 1st embodiment, when carrying out the superimposed display of the electronic image on an optical-observations image. With the input signal of this switch, LED49a and 49b light up at the same time reflection type LCD47 drives. In respect of [48a] the half-reflective semi transmission of the polarization beam splitter 48, a certain one way, for example, the ingredient of a lengthwise direction, is reflected, and the illumination light which emitted LED49a and 49b irradiates with reflection type LCD47. On the other hand, the picture displayed on reflection type LCD47 is expressed as the same magnification as an optical-observations image by said magnification arithmetic circuit 20. Since 90 degrees of direction of wavelength rotate by this LCD47 to the above-mentioned incident light, the light which emitted this reflection type LCD47 penetrates the half-reflective semi transmission side 48a of said polarizing prism 48. being appropriate -- it is alike and image formation is carried out to the intermediate-projection points 5a and 5b with the relay optical system 14, the half prism 100, and the image formation lenses 3a and 3b.

[0048]On the other hand, image formation of said LED49a which is an illumination light source, and the 49b is carried out by the relay optical system 14, the half prism 100, the image formation lenses 3a and 3b, and the eyepieces 4a and 4b like a 1st embodiment on the exit pupil position 6a of these eyepieces 4a and 4b, and 6b. it is alike, and like a 1st embodiment, a way person is an appropriate thing [changing the lighted condition of LED49a and 49b], and it is possible to switch superposition observation to either both eyes or the one eye, and to observe it.

[0049]When an assistant observes picture superimposing like a way person, the input switch which is not illustrated similarly is operated and LED50a and 50b are turned on. Since LCD47 is driven like the above-mentioned at this time, image formation is carried out to the intermediate-projection points 44a and 44b of the observation optical path for assistants with the relay optical system 14, the half prism 100, and the image formation lenses 42a and 42b. Said LED50a and 50b And the relay optical system 14, the half prism 100, the image formation lenses 42a and 42b, Since image formation is carried out by the eyepieces 43a and 43b on the exit pupil position 45a of these eyepieces 43a and 43b, and 45b, by changing the lighted condition of LED50a and 50b like a way person, an assistant can also switch superposition observation to either both eyes or the one eye, and can observe it.

[0050](EFFECT OF THE INVENTION) In addition to a way person's superposition observation, in this embodiment, superposition observation is attained also by the observation optical system by the side of an assistant in the thing of a 1st embodiment with the very easy small composition that LCD47 adds as [one] LED50a which is an illumination light source, and two 50 b.

[0051]Also for an assistant, picture superimposing observation is freely attained [ON/OFF, both eyes/one eye etc.] of its volition in LED50a by the side of an assistant, and 50b by having made light control possible independently to LED49a by the side of a way person, and 49b.

[0052][A 4th embodiment] The operating microscope applied to a 4th embodiment in this invention according to drawing 4 thru/or drawing 6 is explained. However, this embodiment differs from said reflection type LCD47 only in the drive system of LED49a which is an illumination light source, and 49b, 50a and 50b to a 3rd embodiment.

Drawing 5 is a block diagram showing the drive system of reflection type LCD47 and LED49a, and 49b, 50a and 50b, and drawing 6 is a situation map within the observation visual field in an operating microscope.

[0053](Elements of the Invention) As drawing 5 is shown, the two video signals 55 and 56 are inputted into the switcher 30. Here, as the video signals 55 and 56, the data of the outline display of a tumor, the output value of the electrotome, etc. based on a navigation device can be considered, for example. said LED driver 35 -- LED49a, 49b and LED50a, and 50btwo -- it bundles, and it **, and switches like the case of a 2nd embodiment, and lighting is

controlled.

[0054](OPERATION) If the operational input of the switch 32 is carried out in order that a way person may perform superposition observation, a driving signal will be outputted to the control circuit 33 or LCD driver 34. Although it doubles and a driving signal is outputted also to the switcher 30 and LED driver 35, LED driver 35 is controlled to drive LED49a for way persons, and 49b simultaneously with the output of the tumor outline display image according to the output signal of the switcher 30 to a navigation device at this time.

[0055]Next, the output of the switcher 30 is switched to the output-value data image signal 56 of the electrotome, and LED driver 35 is controlled synchronizing with it to drive LED50a for assistants, and 50b. The switch 32 is in the state of ON and the control circuit 33 continues time sharing control for these two operations. Thereby, as a way person shows drawing 6 (a), into an observation visual field, superposition observation of the outline display 55 of a tumor can be carried out, and the assistant can do superposition observation of the output data 56 of the electrotome, as shown in drawing 6 (b).

[0056](EFFECT OF THE INVENTION) At this embodiment, observation of picture superimposing with separate way person and assistant is attained by one LCD according to the display image displayed on reflection type LCD by controlling the exit pupil of a way person and the eyepiece for assistants, and conjugate lighting of illumination light source LED by which position arrangement was carried out by time sharing.

[0057][A 5th embodiment] The operating microscope applied to a 5th embodiment in this invention according to drawing 7 and drawing 8 is explained. However, since the thing of the same name as the 1st thru/or a 4th embodiment and the same number is the same, the explanation is omitted here. Drawing 7 is an explanatory view showing the rough composition of the microscope optical system of an operating microscope, and drawing 8 is an explanatory view of the state of LED arranged on the illumination-light axis of said illumination-light study system.

[0058](Elements of the Invention) The numerals 60 in drawing 7 are one variable power optical system which is arranged behind said object lens 1 and includes the observation optical path of the right-and-left couple by said image formation lenses 3a and 3b and the eyepieces 4a and 4b. The numerals 61a and 61b in the drawing 7 are prism of a right-and-left couple which emits said variable power optical system 60, and is led to said image formation lenses 3a and 3b by making into right-and-left light flux a part of light which penetrated the harp prism 100. This prism 61a and 61b and said image formation lenses 3a and 3b, and the eyepieces 4a and 4b are stored by the body tube housing 62. Focusing on the medial axis O of said object lens 1 and the variable power optical system 60, this body tube housing 62 is pivotable, and is attached to the mirror body housing 63 which stores the object lens 1, the variable power optical system 60, and the half prism 100.

[0059]As shown in drawing 8, as for LED device 65 arranged on the illumination-light axis of said illumination-light study system, two or more LED66a, 66b, and -- are arranged on the base 65a at the same mind circumference [an illumination-light axis] top. In this LED device 65, have a symmetric position relation, respectively. For example, what LED66a and LED66b construct, and LED67a and LED67b construct, and the thing is arranged like the 1st thru/or a 4th embodiment mentioned above by the exit pupil positions 6a and 6b of the eyepieces 4a and 4b, and conjugate physical relationship.

[0060](OPERATION) A way person operates the switch which does not perform and illustrate solid observation with the observing power of a request of the operating area P like a 1st embodiment, and makes reflection type LCD47 and LED device 65 drive. At this time, image formation of LED66a and LED66b of LED device 65 is carried out to the exit pupils 6a and 6b of the eyepieces 4a and 4b by the illumination-light study system 51, the relay optical system 14, the image formation lenses 3a and 3b, and the eyepieces 4a and 4b, and superposition observation of an electronic image can be performed like a 1st embodiment.

[0061]Next, a way person changes the physical relationship of the body tube housing 62 and the mirror body housing 63, when the observation posture over the operating area P is painful. For example, if 90 degrees of body tube housing 62 are rotated in the arrow 64 direction of [in drawing 7], Image formation of LED67a from which said LED66a and LED66b, and a 90-degree position differ among said LED devices 65, and the 67b is carried out to the exit pupils 6a and 6b of the eyepieces 4a and 4b by the illumination-light study system 51, the relay optical system 14, the image formation lenses 3a and 3b, and the eyepieces 4a and 4b. Therefore, the way person can perform superposition observation of an electronic image also in this case.

[0062](EFFECT OF THE INVENTION) In this embodiment, since the illumination light which projects picture superimposing is certainly led to right-and-left both eyes even if it changes the position of the eyepiece of the circumference of the medial axis O to the operating area P, bright positive superposition observation is always possible.

[0063][A 6th embodiment] The operating microscope applied to a 6th embodiment in this invention according to drawing 9 is explained. At this embodiment, the shading means is added into a substance observation optical system to a 1st embodiment mentioned above, and other composition is the same as that of a 1st embodiment. Drawing 9 is an explanatory view of the rough composition of an operating microscope.

[0064](Elements of the Invention) The input means of the foot switch etc. which the numerals 70 in drawing 9 are the gobos for shading selectively the light flux between said variable power optical system 2a, and 2b and the half prism 100, and do not illustrate this gobo 70. It is arranged movable by the drive mechanism which is not illustrated at the position 70 shown by a figure inner substance line, and the position 71 of the dashed line. Via said switcher 30, the image pick of the TV camera which was connected to the endoscope which is not illustrated in addition to the tumor outline display image by the above-mentioned navigation device is connected to said transmission type LCD11 so that a display is possible.

[0065](OPERATION) When a way person is going to observe the observation blind part of an operating microscope, he uses auxiliary observing means, such as an endoscope. At this time, said switcher 30 is operated and an endoscope image is displayed on LCD11. The foot switch which is not illustrated is operated according to this, and the gobo 70 is moved to the position shown with numerals (71, 72). At this time, the single-sided optical path (variable power optical system 2b side) of a substance observation optical system is shaded with the gobo 70. It doubles by this foot switch operation, and only LED12b is turned on. Then, a way person observes an operating microscope picture by the eyepiece 4a side (left eye), and it becomes observable [the endoscope image displayed on LCD11] in the eyepiece 4b side (right eye).

[0066]When what is called a solid endoscope with two observation optical paths is used as an endoscope, said gobo 70 is moved to the position shown with the numerals 72, it combines, and both LED12a and 12b are made to turn on. In this case, an operating microscope picture is covered, and since only a solid endoscope image with azimuth difference is led to the eyepieces 4a and 4b of an operating microscope, respectively, it can perform solid observation of an endoscope image.

[0067]Of course, as a 1st embodiment mentioned above showed, various superposition observation according to the picture and observation use to display, such as the one eye, both eyes, two dimensions, and a three dimension, is possible by choosing LED12a to turn on and 12b.

[0068]it is the easy composition of adding a shading means to a mirror body part in this embodiment in addition to one LCD — the above-mentioned superposition observation — in addition, completely different electronic images, such as an endoscope image, are observable where the picture of an operating microscope is interrupted.

[0069]Although this embodiment indicated the display of the endoscope image, CT, the way previous image of MR imaging, etc. are utilizable for various uses according to the situation of an operation of the finder of an operating microscope because **** connects a picture via a switcher.

[0070]This invention is not limited to the thing of each embodiment mentioned above, and can be applied to other gestalten. According to the explanation mentioned above, the thing of the matter which combined arbitrarily the matter enumerated to the matter enumerated below and the following is obtained.

[0071]The image formation optical system of the right-and-left couple which makes light flux emitted from the objective optical system which enters the light from a <additional remark (1)> object, and this objective optical system a right-and-left-eyes image, and carries out image formation, The eyepiece optical system of the right-and-left couple which leads said right-and-left-eyes image to an observer's right and left eyes, respectively, The optical modulation means which displays an electronic image, and the illumination-light study system which irradiates said optical modulation means with the illumination light of two or more illumination methods in which lighting operation is possible separately, the position of the exit pupil have a relay optical system which leads the electronic image generated by said optical modulation means to the image formation position by the image formation optical system of said right-and-left couple, and according to said eyepiece optical system, and the position of said illumination method — abbreviated — the operating microscope having arranged in the conjugate position.

[0072](2) The objective optical system which enters the light from an object and emits afocal light flux, The image formation optical system of the right-and-left couple which makes this afocal light flux a right-and-left-eyes image, and carries out image formation, The eyepiece optical system of the right-and-left couple which leads said right-and-left-eyes image to an observer's right and left eyes, respectively, The optical modulation means which displays an electronic image, the illumination method which irradiates this optical modulation means with the illumination light, and an illumination-light study system, In the operating microscope which has a light guide means which carries out the light guide of the electronic image generated by said optical modulation means into said afocal light flux, and a relay optical system which leads this electronic image to the image formation position by the image formation optical system of said right-and-left couple, the exit pupil position by said eyepiece optical system, and the position of said illumination method — abbreviated — the thing having arranged in the conjugate position.

[0073](3) the exit pupil position of the right-and-left couple [establish said at least two or more illumination methods, and] according [each illumination method] to the eyepiece optical system of said right-and-left couple — respectively — abbreviation — a thing given in (1) having arranged in the conjugate position, or (2).

[0074](4) A thing given in (1), wherein the projection image of said last illumination method by which image formation is carried out in the exit pupil position of said eyepiece optical system uses this diameter of an exit pupil, abbreviated coincidence, or less than it, or (2).

[0075](5) A thing given in (1) having a control means which switches the lighted condition of said two or more illumination methods, or (2).

[0076](6) A thing given in (5) having selection change ***** for the picture displayed on said optical modulation means according to the lighted condition of said two or more illumination methods.

[0077](7) A thing given in (1) having a shading means which shades a part or all of light flux that is emitted from said object lens.

[0078](8) A thing given in (2) having a shading means which shades a part or all of light flux that is emitted from said object lens or an afocal variable power optical system.

[0079]

[Effect of the Invention]As explained above, according to this invention, in the operating microscope in which a superimposed display is possible, superposition observation of the display image by an optical modulation means comes to be brightly carried out [in / on the operating microscope in which a superimposed display is possible, and / for an electronic image / an eyepiece optical system] certainly at the magnified observation image of an

operating area in an electronic image in the magnified observation image of an operating area.

[Translation done.]

* NOTICES *

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the rough composition of the microscope optical system of the operating microscope concerning a 1st embodiment in this invention, and is an explanatory view of the state which shows the image formation of the electronic image displayed on transmission type LCD superimposed on microscope observation images.

[Drawing 2] It is an explanatory view of the state which shows the image formation of the light source which illuminates transmission type LCD in the microscope optical system of said operating microscope.

[Drawing 3] the transmission type in the operating microscope concerning a 2nd embodiment in this invention -- it is a block diagram showing the drive system of LCD and LED.

[Drawing 4] It is an operating microscope concerning a 3rd embodiment in this invention, and is a perspective view showing the rough composition of the microscope optical system of the form which added the subside observation optical path in the form of the operating microscope concerning a 1st embodiment.

[Drawing 5] the transmission type in the operating microscope concerning a 4th embodiment in this invention -- it is a block diagram showing the drive system of LCD and LED.

[Drawing 6] It is a situation map within the observation visual field in the operating microscope concerning a 4th embodiment in this invention.

[Drawing 7] It is an explanatory view showing the rough composition of the microscope optical system of the operating microscope concerning a 5th embodiment in this invention.

[Drawing 8] It is an explanatory view of the state of LED arranged on the illumination-light axis of said illumination-light study system in the operating microscope concerning a 5th embodiment in this invention.

[Drawing 9] It is an explanatory view of the rough composition of the microscope optical system of the operating microscope concerning a 6th embodiment in this invention.

[Drawing 10] It is an explanatory view of the example which established the optical system which displays the picture superimposing in the conventional operating microscope.

[Description of Notations]

1 -- Object lens

3a, 3b -- Image formation optical system of a right-and-left couple

4a, 4b -- Eyepiece of a right-and-left couple (eyepiece optical system)

5a, 5b -- Image formation point

6a, 6b -- Exit pupil

11 -- Transmission type LCD (liquid crystal modulator)

12a, 12b -- LED of a right-and-left couple

14 -- LCD relay optical system

[Translation done.]